TDK·Lambda

Specification Document
69336

# Vega SmartPlus Application Notes

**Contents:**

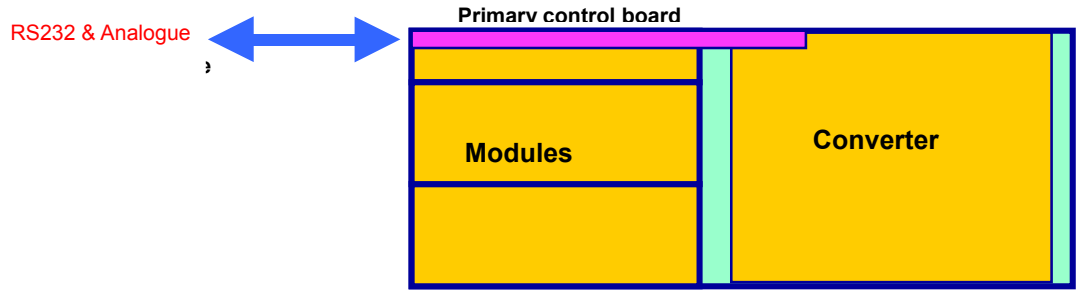


| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
| Drawn: | Julia Morss - Manufacturing Information Systems | | | | | | |

# Vega SmartPlus Application Notes

## 1 System Overview

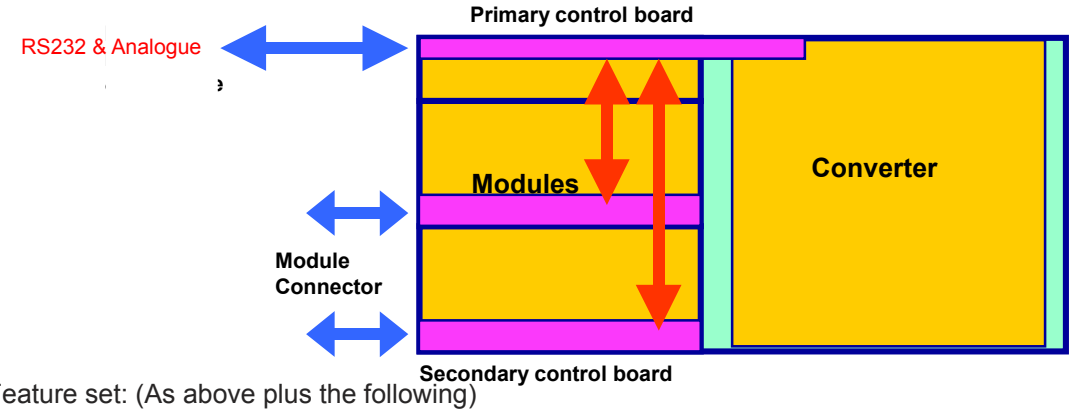
### 1.1 Vega SmartPlus




Feature set: Serial communication with PSU
- PSU status (Fan ok, Fan warning, Over voltage, Over temperature, AC fail)
- Operating hours
- Serial number

Global inhibit/enable via hardware and software methods
AC fail hardware signal
Fan ok hardware signal
Over temperature hardware signal

### 1.2 Vega SmartPlus with Optional Secondary Features




Feature set: (As above plus the following)

Voltage and Current Monitor via softwareModule status (on/off, module good, current limit) via software
Programmable Output Voltage (via software or external analogue signal)
Programmable Current Limit (latching or hiccup) via software
Output Sequencing
Ouput Inhibit/Enable via hardware and software
Output Good Signal (tracking or fixed high and low levels)
Global DC Good Signal
System Reset Signal

| Issue: | 1 | 2 | 3 | 4 | | | |
|---|---|---|---|---|---|---|---|
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
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# Vega SmartPlus Application Notes

## 2 Software installation

To install the Vega SmartPlus software:

a) Insert the Vega SmartPlus Software CD-ROM into the CD-ROM drive.
b) Follow the on-screen instructions.

### 2.1 Communication

Serial communication with the PSU is via an RS-232 protocol. The data rate is 9600 baud with 8 bit data, 1 stop bit, no parity and no hardware flow control. There is the facility for daisy chaining multiple units.

The PSU can be controlled via the serial interface in a number of different ways:

a) Using the Vega GUI software – this provides an interactive control environment through which all functions of the power supply can be exercised. The GUI has two main parts, an eeprom configurator and an interactive monitor.
The eeprom configurator allows the user to set the default settings of the power supply and retrieve serial numbers of the unit.
The interactive monitor allows the user to check the status, output voltage, output current and operating hours of the power supply. The monitor also provides the facility to change the output voltage of the modules as well as control the inhibit/enable state of the modules and the power supply.
See the ActiveX help file for more details.

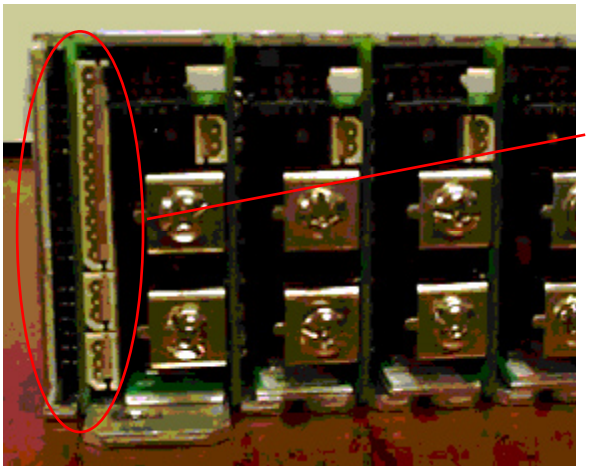
b) Using the ActiveX controls – the purpose of the ActiveX is to simplify the process of communicating with the Vega by adding a level of abstraction which composes and interprets the actual commands and responses sent and received from the Vega. This allows the user to include the power supply controls into their own system.
See the ActiveX help file for more details.

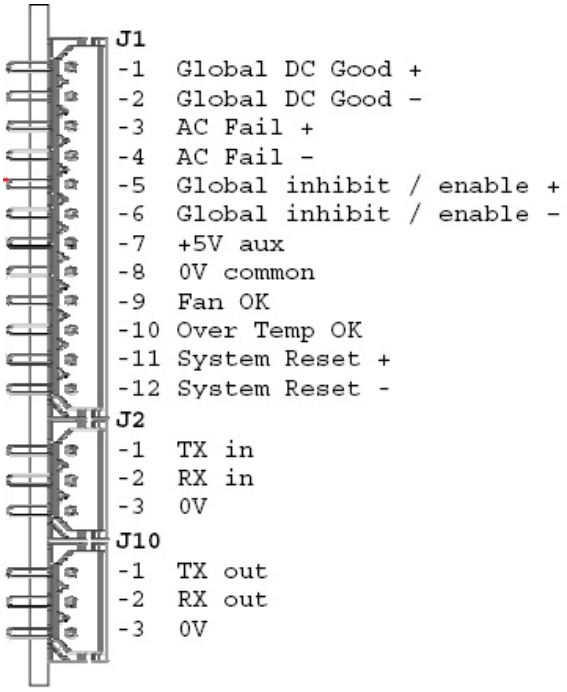
c) Using the hex string commands – with reference to the Vega Development Kit documentation the user can formulate their own commands using the structure and values described. The commands to the power supply would have to be encoded into hex strings and the replies decoded into meaningful results.

# Vega SmartPlus Application Notes

## 3 Primary Option Connection

Customer side signals and inputs are presented via one 12-way connector (J1), and two 3-way connectors ( J2, and J10) as shown below:






Mating Connector Information:

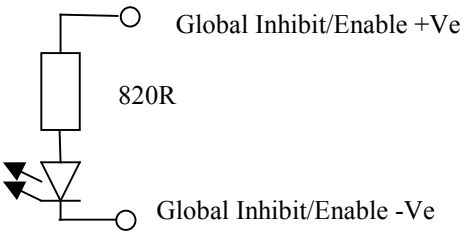
| | |
|---|---|
| Housings: | 12-way: Molex 50-37-5123 |
| | 3-way: Molex 50-37-5033 |
| Crimp pins | Molex 08-70-1039 or 08-70-1040 |
| Hand crimp tool | Molex 11-26-0167 (Japan) |
| | Molex 11-01-0194 (Europe and USA) |

# Vega SmartPlus Application Notes

## 4 Primary features

### 4.1 Global inhibit/enable

The global inhibit/enable input is an optically isolated input that turns the output of the unit on or off. At power on, the PSU remains disabled regardless of the state of the inhibit/enable input until the option board has initialised. The initialisation time is fixed and will be no longer than 5ms following start-up of the converter. After initialisation, the option board will enable the power supply. The PSU is disabled by driving current into the global inhibit/enable + input. To change these default settings, see the software section below.




Current drawn at 5V is approx. 5mA. Maximum voltage that should be applied across the pins is 6V.
External resistors can be added for use with signals >5 volt.
Note that when the PSU is inhibited the residual voltage at the output terminals will be <<0.6V.

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|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
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# Vega SmartPlus Application Notes

### 4.1.1 Global Inhibit/Enable software options

The power supply can be turned on and off via a software command. See ActiveX help file and Vega Development Kit for details.

Note that when the power supply is off due to a hardware signal, the software command will not be able to turn the power supply on. It can only be turned on again by returning the hardware input to the on state

If the PSU is turned on then it can be turned off by sending a software command. It can be turned back on by either a software command, or by forcing the hardware input into the off state for at least 5ms and then returning it to the on state.

The operation of the global inhibit/enable can be modified by altering the default settings of the PSU.

#### 4.1.1.1 Start up state

When ac mains is applied to the PSU, the default setting is that the power supply is on. This can be set so that the power supply is initially off. The power supply can then be enabled in two ways:

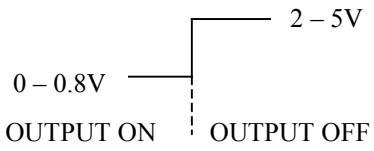
1) Using a software command.
2) Using the hardware signal. In this case, the hardware signal must be in the off state for at least 5ms before changing to the on state to turn on the power supply.

#### 4.1.1.2 Signal function:

The default setting of the power supply is such that driving current into the inhibit/enable pin turns the power supply off and is otherwise on. This setting can be modified so that driving current into the inhibit/ enable pin turns the power supply on and is otherwise off.

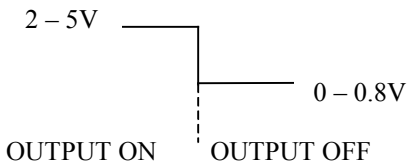
**Default signal set-up**

Global inhibit/enable + to be taken to 2-5V with respect to global inhibit/enable-, to turn output off.




**Inverted signal set-up**

Global inhibit/enable + to be taken to 2-5V with respect to global inhibit/enable-, to turn output on.




**See also:** ActiveX help file
Vega Development Kit

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|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
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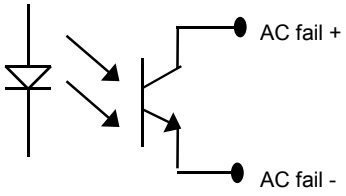
# Vega SmartPlus Application Notes

## 4.2 AC Fail

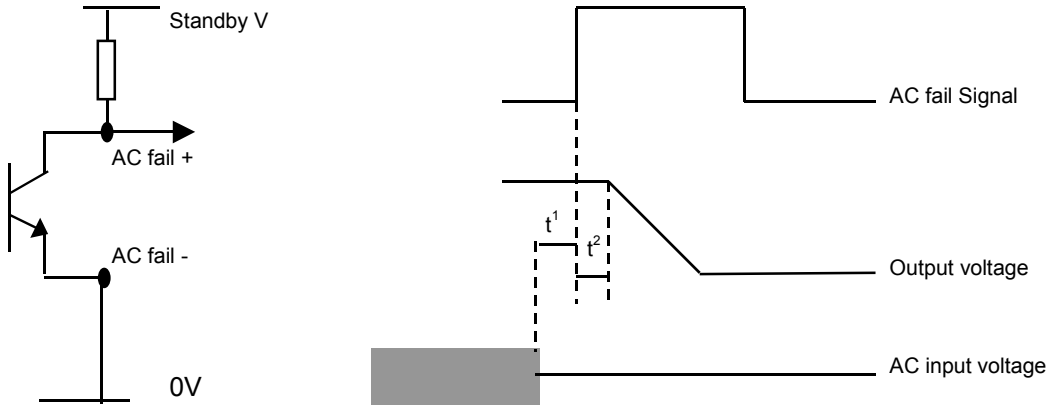
Isolated opto transistor which turns off when input supply is no longer present, indicating all outputs will turn off after 5mS (min) at max output power, at any input voltage (90-264VAC)



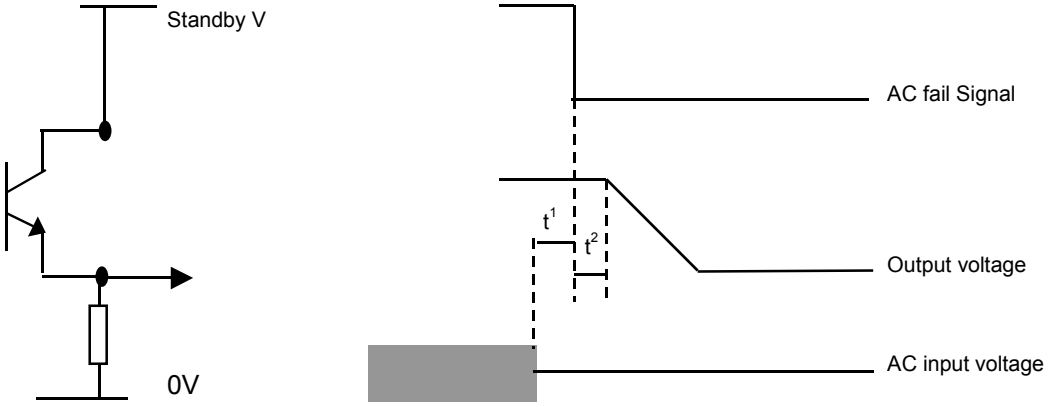

**Max ratings**

Vce max 30V
Vce sat 0.4V at 1mA current
Ic max 1mA

Signal polarity can be configured as **High on fail**




or **Low on fail**




$t^1$ is variable depending on output current of all outputs
$t^2$ = 5mS minimum at maximum rated output of psu, at any input voltage (90-264V)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
| Drawn: | Julia Morss - Manufacturing Information Systems | | | | | | |

# Vega SmartPlus Application Notes

Note: This output can also be triggered by a thermal shutdown condition providing a minimum of 5ms warning to loss of output power. The thermal shutdown activates when the forward or the boost converter heatsinks reach a certain temperature. When activated the power supply will shutdown, disabling the outputs. This is not necessarily related to the operating ambient temperature of the power supply and should not be used as an indicator of such.

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|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
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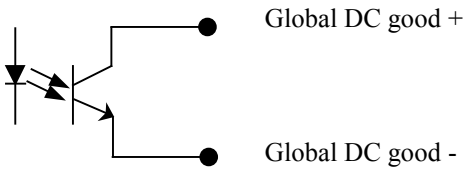
# Vega SmartPlus Application Notes

## 4.3 Global dc good

Global dc good is an optically isolated output that provides an indicator that all outputs fitted with the secondary option have been established within their limits and are communicating correctly with the primary option.

Output stage is:




Maximum Vce voltage rating 30V
Saturation voltage <0.4V with Ic = 1mA
Ic max = 1mA

The global dc good optocoupler is on when the output voltages are within their limits with correct communication established and off otherwise. At start up, the optocoupler will remain off regardless of conditions until the option has initialised. The global dc good signal will be asserted within 200ms of the last module with a secondary option being enabled and established correctly.

**See also:** ActiveX help file
Vega Development Kit

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
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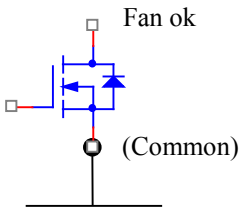
| Drawn: | Julia Morss - Manufacturing Information Systems | | | | | | |

# Vega SmartPlus Application Notes

## 4.4 Fan ok

This provides an open drain output signal indicating the failure of the fan. This is detected both when the fan is stopped and when the fan is disconnected.




Maximum drain source voltage ($V_{DS}$): 50V
Maximum drain current (dc value): 50mA

The polarity of this signal has been programmed such that “Fan ok” is indicated by the Fan ok pin being pulled low.

### 4.4.1 Fan ok software options

The polarity of this signal can be reprogrammed via a software command such that “Fan ok” or “Fan fail” is indicated by the Fan ok pin being pulled low.

The fan status can also be determined by a software command. This command will return a status byte indicating if the fan has failed or if it has been disconnected. The status byte will also indicate if the fan speed has slowed down to less than 80% of its nominal speed.

**See also:** ActiveX help file
Vega Development Kit

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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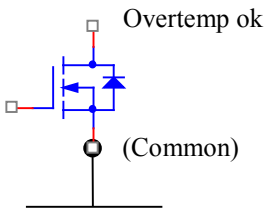
# Vega SmartPlus Application Notes

## 4.5 Over-temperature ok

This provides an open drain output signal indicating the thermal shutdown of the converter has activated.




Maximum drain source voltage ($V_{DS}$): 50V
Maximum drain current (dc value): 50mA

The polarity of this signal has been programmed such that “Over temp ok” is indicated by the Overtemp ok pin being pulled low.

Note: The thermal shutdown activates when the forward or the boost converter heatsinks reach a certain temperature. When activated the power supply will shutdown, disabling the outputs. This is not necessarily related to the operating ambient temperature of the power supply and should not be used as an indicator of such.

### 4.5.1 Over-temperature ok software options

The polarity of this signal can be reprogrammed via a software command such that “Overtemp ok” or “Overtemp fail” is indicated by the Overtemp ok pin being pulled low.

The over temperature status can also be determined by a software command. This command will return a status byte indicating if the over-temperature protection has operated.

**See also:** ActiveX help file
Vega Development Kit

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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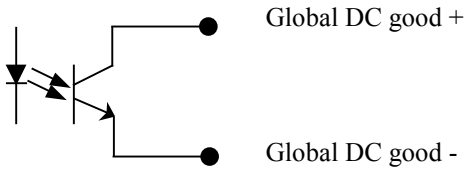
# Vega SmartPlus Application Notes

## 4.6 System Reset

System reset an optically isolated output that provides an indicator for two conditions:

1) At power up, the global dc good signal has been established for at least 200ms.
2) At power down, the ac fail signal has been asserted for at least 2ms.

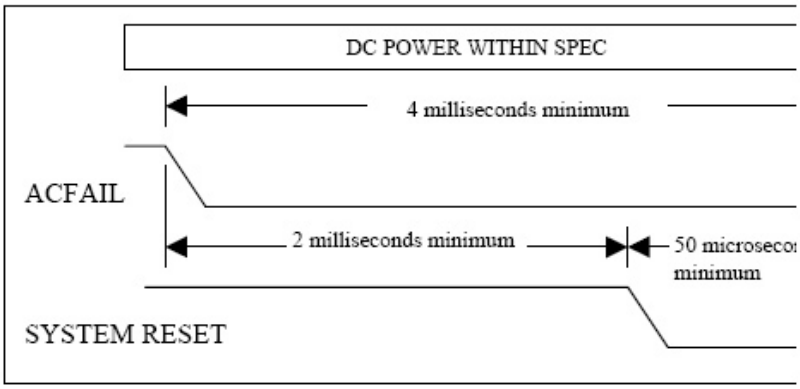
Output stage is:



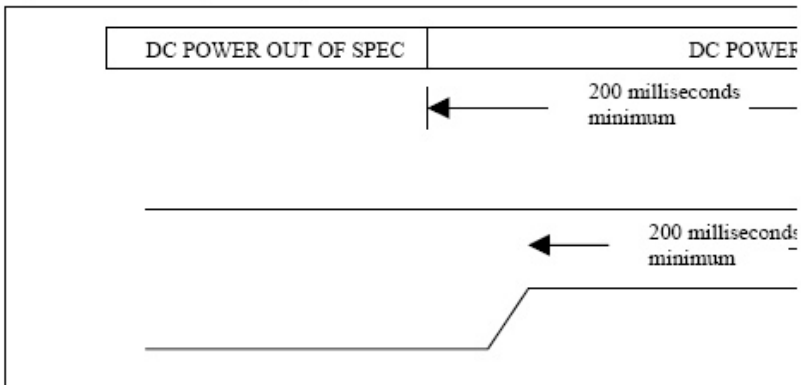

Maximum Vce voltage rating 30V
Saturation voltage <0.4V with Ic = 1mA
Ic max = 1mA

The system reset optocoupler is on when the global dc good has been established for at least 200ms. The optocoupler is off if either the ac fail signal has been asserted for at least 2ms or if the global dc good signal is not established.
At start up, the optocoupler will remain off regardless of conditions until the option has initialised.

System reset signal at power down:




System reset at power up:




**See also:** ActiveX help file
Vega Development Kit

| Issue: | 1 | 2 | 3 | 4 | | | |
|---|---|---|---|---|---|---|---|
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
| Drawn: | Julia Morss - Manufacturing Information Systems | | | | | | |

## 4.7 Auxiliary 5V supply

This is available for powering auxiliary circuits and is present when AC input is applied regardless of the global inhibit/enable state of the PSU or the output modules.
The isolated secondary related output is rated as Safety Extra Low Voltage and is protected against short-circuit. The auxiliary output will rise more than 50ms before the main outputs initialise. The auxiliary supply will hold up for a minimum of 300ms after the AC fail signal has been asserted.

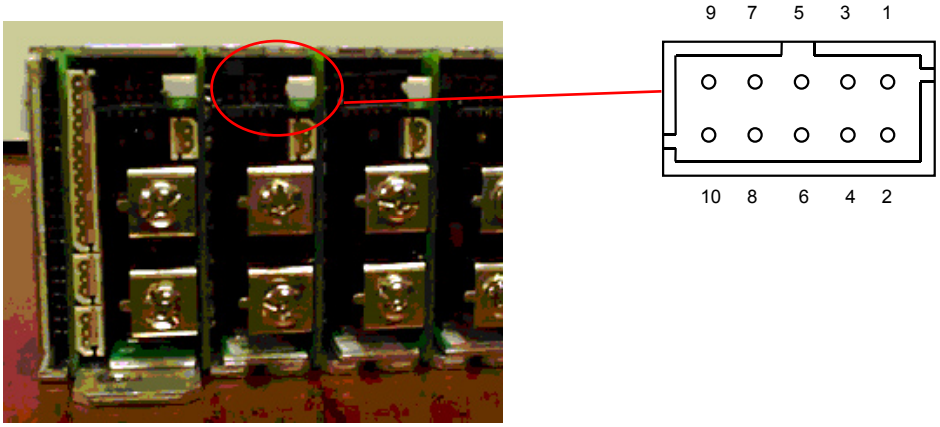
| Parameter | Condition | Value | Unit |
|---|---|---|---|
| Output voltage | | 5 (+/- 5%) | V |
| Max continuous output current | | 300 | mA |
| Isolation to earth | | 500 | Vdc max |

# Vega SmartPlus Application Notes

## 5 Secondary Features (where fitted)

### 5.1 Secondary Option Connection

Customer side signals and inputs are presented via a ten-way connector (J1), as shown below:




Viewed from output end of PSU

**Mating connector information:**
Note: housing and pins supplied with each power supply.
Housing: Molex 51110-1060
Crimp pin: Molex 50394-8051
Hand Crimp Tool: 69008-0959 (Europe or Japan) Or 11-01-0204(USA)

| Pin No | Function |
|---|---|
| 1 | Analogue programming: Voltage or resistive w.r.t. common |
| 2 | Module Good Emitter of uncommitted optocoupler |
| 3 | +Ve Sense. *1 |
| 4 | Module Good Collector of uncommitted optocoupler |
| 5 | Current Share |
| 6 | Common |
| 7 | Current Share |
| 8 | Module Inhibit/Enable -Ve |
| 9 | -Ve Sense. *1 |
| 10 | Module Inhibit/Enable +Ve |

Note *1: Option board +ve and -ve sense pins are internally connected to the module sense connector.

| Issue: | 1 | 2 | 3 | 4 | | | |
|---|---|---|---|---|---|---|---|
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
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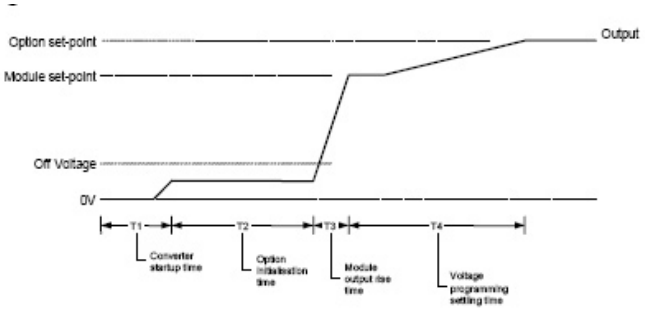
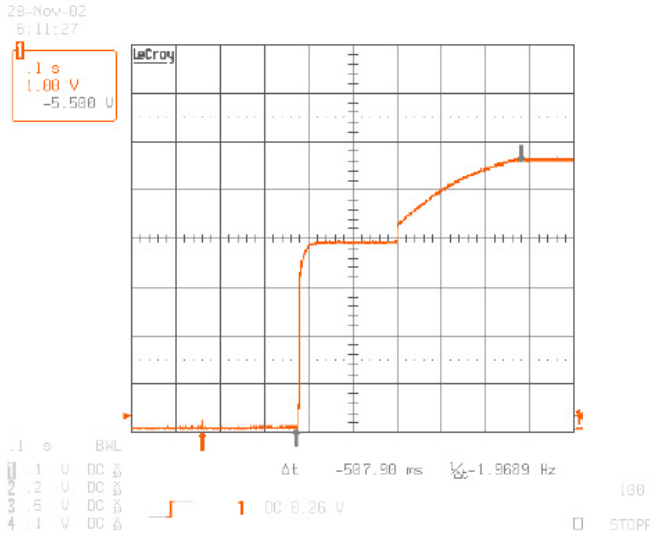
# Vega SmartPlus Application Notes

## 5.2 Default Output Voltage Turn-on Characteristics

At power up, a period of time is required for the micro controller on the option board to reset and initialise. During this time, the output voltage of the module is disabled. The off state voltage of all modules is < 0.6V. Once the option board has initialised, the output is enabled and rises to the set voltage




The diagram above illustrates the situation at when power is first applied to the unit.
During T1, internal auxiliary supplies are established, and the converter starts. The module output voltage rises to its inhibited level, and power is supplied to the option board.
During T2, the option board resets and initialises.
At the end of T2, the module is enabled, and the output voltage rises during T3 to the value set by the potentiometer on the module.
During T4, the output rises to the value set by the option.




Typical Plot
B1H module
0ms turn on delay
Preset voltage: 5.5V
T4 approximately 500ms for maximum voltage set point.

| Issue: | 1 | 2 | 3 | 4 | | | |
|---|---|---|---|---|---|---|---|
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
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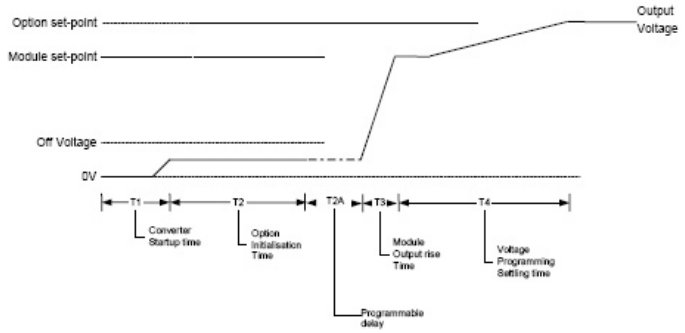
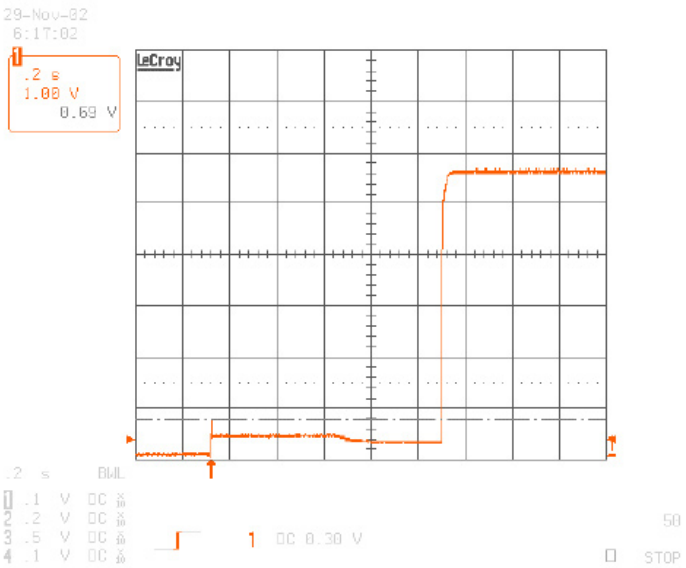
# Vega SmartPlus Application Notes

## 5.3 Delayed Start-up/Sequencing

Delayed start-up introduces a programmable delay between the power being applied, and the output of the module being enabled. The delay can be set to between 0 and 65s in 1ms steps, and is stored in EEPROM. The delay is indicated by period T2A on the diagram below. Delayed start-up can be used to control the sequence in which outputs rise.




Note: When a delayed start-up is implemented, there will be a small voltage spike on the output of the module when the converter turns on. This will be no greater than 0.8V for 1 and 2 turn modules, 1.2V for 3 turn modules and 6V for 4 and 5 turn modules.
Typical plot:
B1H module
1000ms turn on delay
Preset voltage: 5.5V

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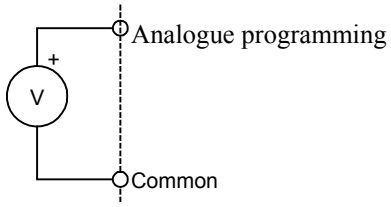
# Vega SmartPlus Application Notes

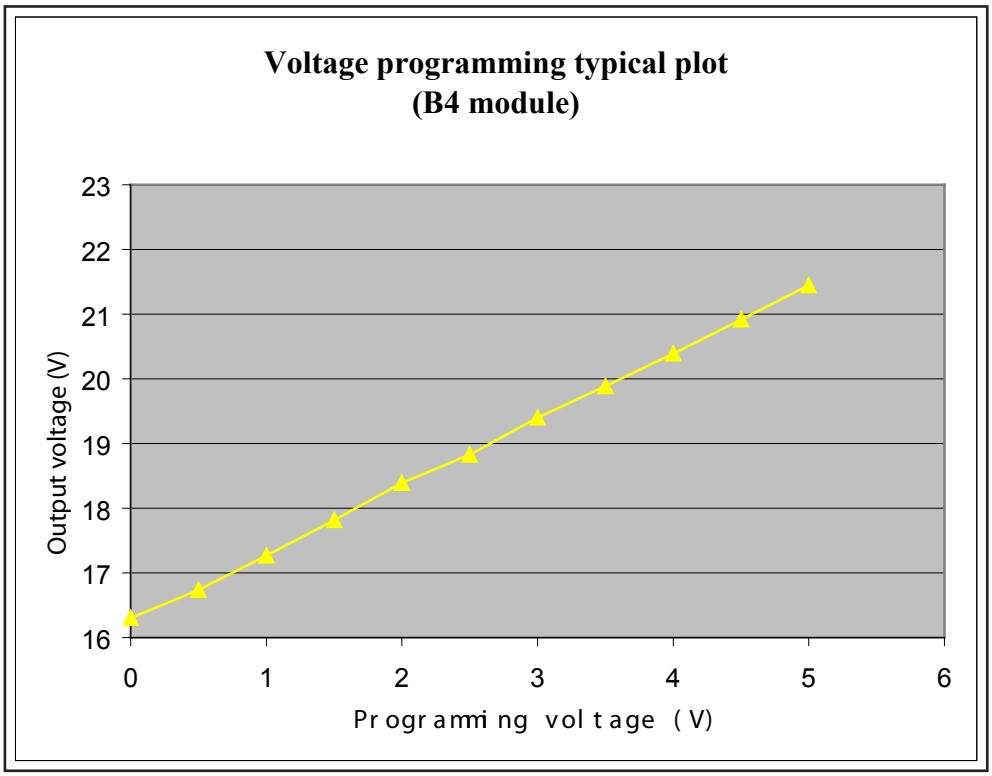
## 5.4 Output Voltage Programming

The output voltage of a secondary module is determined from three different factors. These are the setting of the potentiometer on the module itself, the external analogue programming input and the default start-up voltage stored in EEPROM.

The external analogue programming input allows the output voltage of a module to be set by an external voltage. Applying a programming voltage of 5V will cause the module to provide its highest specified output voltage. Applying a programming voltage of 0V (open circuit) will cause the module to provide its lowest specified output voltage.




Maximum programming voltage: 5V
Minimum programming voltage: 0V
Input impedance: 20kΩ




Note: The module output voltage will be set to the highest of the programming register, the external analogue programming input, and the potentiometer on the module

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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# Vega SmartPlus Application Notes

### 5.4.1 Output Voltage Programming Software options

At power up, the programming register on the secondary option is initialised according to the default value stored in EEPROM. Subsequent software voltage programming commands will overwrite the programming register, which, depending on the setting of the external analogue input and the module potentiometer may cause the output voltage to change.

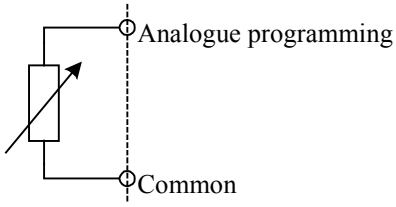
Voltage programming allows the output voltage of a module to be set using a 'Set Output Voltage' software command. The voltage set by this command is not stored in EEPROM and thus if the power supply is turned off (by removal of AC mains or by a global inhibit action) this voltage set point is lost.

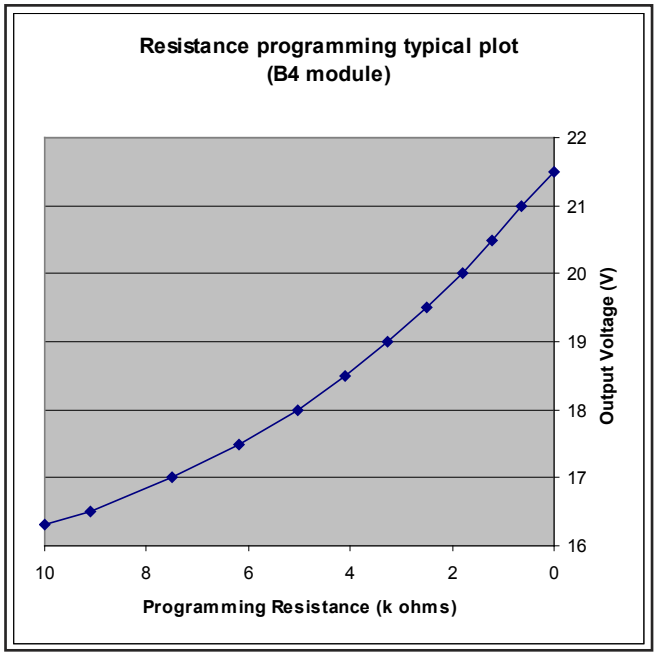
At power on, the 'Set Output Voltage' command is not available for 1.5s from power being applied, whilst the converter starts-up and the option board resets and initialises.

The default start-up voltage can also be programmed and saved in EEPROM. This will be the output voltage of the module at turn on providing neither the potentiometer nor the analogue programming input is forcing the module to provide a higher output.

The mode of the analogue programming can be changed between voltage programming and resistance programming by sending a software command.

In resistance programming mode, a programming resistance of zero$\Omega$ (short-circuit) will cause the module to provide its highest specified output voltage. Applying a programming resistance of 10k$\Omega$ (or greater) will cause the module to provide its lowest specified output voltage.




**See also:** ActiveX help file
Vega Development Kit

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| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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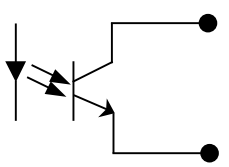
# Vega SmartPlus Application Notes

## 5.5 Module Good

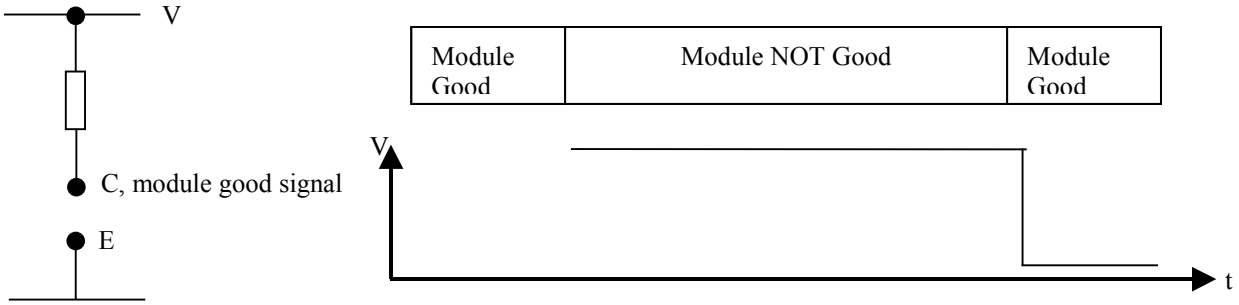
Module good is an optically isolated output that indicates that the output voltage of the module is within certain limits. These limits consist of two parts: absolute limits stored in EEPROM, and relative limits. The relative limits are ±12.5% of the set point and will track the output voltage of the module, as it is adjusted. The module good optocoupler is on when the output voltage is within the limits and off otherwise. At start up, the optocoupler will remain off regardless of the output voltage until the option has initialised. The factory default setting is that the absolute low limit is set to zero (not active), the absolute high limit is set to the value shown in the table in section 5.5.1

Output stage is:

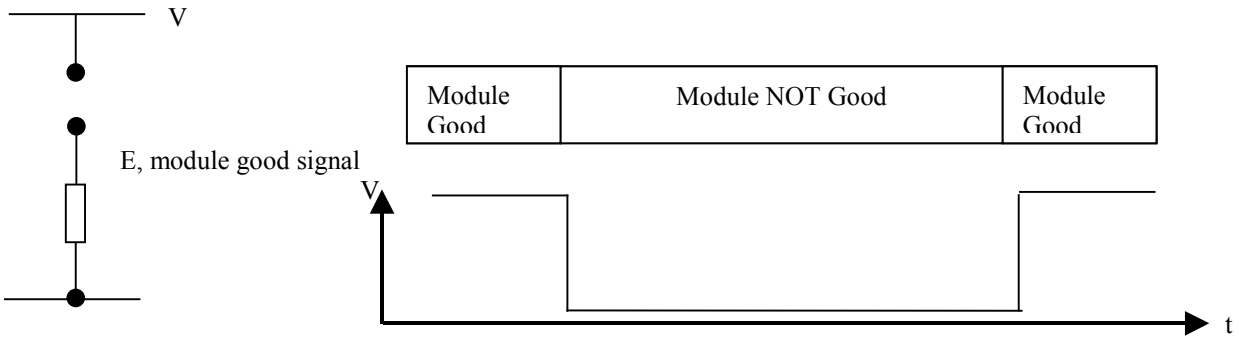



Vce max 30V
Vce sat <0.4V at 1mA current
Ic max 1mA

This can be configured as **either:**




Or:

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| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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# Vega SmartPlus Application Notes

### 5.5.1 Module Good software options

The absolute limits can be altered via software commands. If either limit is set to zero, then that limit is ignored. When the absolute limits are active the relative limits also remain active, the module good signal is given when both sets of limits are met. The absolute limits can be set to any value between minimum specified voltage –12.5% and maximum specified voltage +12.5%

The module good signal incorporates hysteresis so that the output does not oscillate, this is achieved by shifting the failed limit by 6.25% (down for an upper limit, up for a lower limit) until the output then comes within this new limit, then it is returned to it's original value. This is true for both relative and absolute limits.
The maximum output voltage for correct module good operation and the default upper absolute limit is shown in the table below

| Module Type | Max Upper MG Setup (default setting) | Max Module Output Setting |
|---|---|---|
| B1H | 5.9 | 5.25 |
| B1L | 4.9 | 3.8 |
| B2 | 9.9 | 9 |
| B3 | 19.3 | 16.2 |
| B4 | 23.2 | 21 |
| B5 | 33.6 | 30 |
| C1 | 4.9 | 4.1 |
| C1Y | 4.9 | 4.1 |
| C3 | 17.8 | 16.2 |
| C4 | 23.2 | 21 |
| C5 | 33.6 | 30 |
| D1H | 5.9 | 5.25 |
| D1L | 4.9 | 3.8 |
| D2 | 8.9 | 9 |
| D3 | 17.8 | 16 |
| D4 | 27.7 | 21.5 |
| D5 | 33.6 | 28 |
| E1 | 4.0 | 3.5 |
| E2 | 8.9 | 8 |
| E3H | 17.8 | 15 |
| E3L | 17.8 | 13.9 |
| E4 | 27.7 | 19.9 |
| E5H | 33.6 | 28 |
| E5L | 33.6 | 24 |
| F1 | 4.0 | 3.5 |
| F2 | 8.9 | 8 |
| L1 | 5.9 | 5.25 |

**See also:** ActiveX help file
Vega Development Kit

| Issue: | 1 | 2 | 3 | 4 | | | |
|---|---|---|---|---|---|---|---|
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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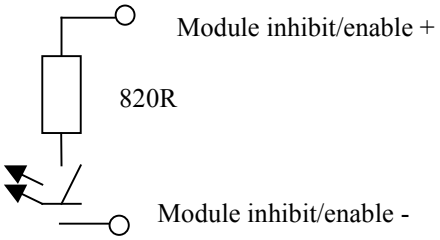
# Vega SmartPlus Application Notes

## 5.6 Module output Inhibit/Enable

The module output inhibit/enable input is an optically isolated input that turns the output of a module on or off.




Current drawn at 5V is approx. 5mA. Maximum voltage that should be applied is 6V.
Note that when the output is inhibited the residual voltage at the output terminals will be <0.6V.

At power on, the module remains disabled regardless of the state of the inhibit/enable pin until the option board has initialised and the start up delay has elapsed. See sections 5.2 and 5.3 for details of turn-on characteristics.

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| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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# Vega SmartPlus Application Notes

### 5.6.1 Module Output Inhibit/Enable Software options

The module can be turned on and off via a software command. See ActiveX help file and Vega Development Kit for details.

Note that when the module is off due to a hardware signal, the software command will not be able to turn the power supply on. It can only be turned on again by returning the hardware input to the on state

If the module is turned on then it can be turned off by sending a software command. It can be turned back on by either a software command, or by forcing the hardware input into the off state for at least 5ms and then returning it to the on state.

The operation of the module inhibit/enable can be modified by altering the default settings of the PSU.

#### 5.6.1.1 Start up state

When the PSU is turned on, the default setting is that the module is on. This can be set so that the module is initially off. The module can then be enabled in two ways:

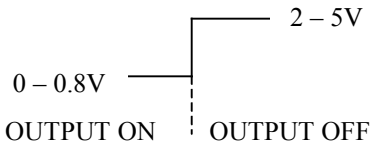
1) Using a software command.
Using the hardware signal. In this case, the hardware signal must be in the off state for at least 5ms before changing to the on state to turn on the module.

#### 5.6.1.2 Signal function

The default setting of the module is such that driving current into the inhibit/enable pin turns the module off and is otherwise on. This setting can be modified so that driving current into the inhibit/enable pin turns the module on and is otherwise off.

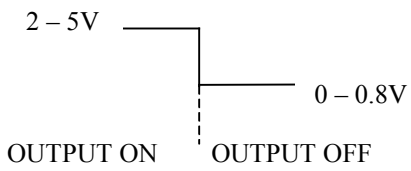
**Default signal setup**

Module inhibit/enable + to be taken to 2-5V with respect to global inhibit/enable-, to turn output off




**Inverted signal setup**

Module inhibit/enable + to be taken to 2-5V with respect to global inhibit/enable-, to turn output on.




**See also:** ActiveX help file
Vega Development Kit

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| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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## 5.7 Module Current Limit Option Modes

There are four mutually exclusive modes of operation for a secondary option, see sections below for descriptions.

Default constant current
Hiccup current limiting
Latching current limiting
Current sharing

The mode is determined by the contents of a location in EEPROM. In normal, hiccup, or latching current limit modes, current sharing functionality is disabled. In current sharing mode, latching and hiccup current limits are disabled.

| | Default | Hiccup | Latching | Sharing |
|---|---|---|---|---|
| Module Good | Y | Y | Y | Y |
| On/Off | Y | Y | Y | Y |
| Voltage Programming | Y | Y | Y | N* |
| Hiccup Current Limit | N | Y | N | N |
| Latching Current Limit | N | N | Y | N |
| Delayed Start-up | Y | Y | Y | Y |
| Current Sharing | N | N | N | Y |

* Refer to section 5.7.4

### 5.7.1 Default Constant Current Mode

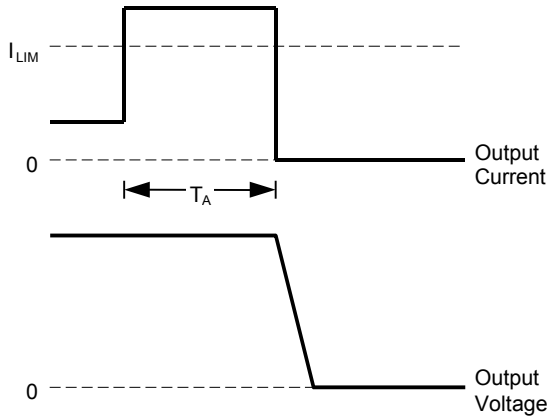
In “Default Constant Current” mode, the option does not have any additional current limit features other than that of the host output module. When the load exceeds 105-120% of the module rated current, the output voltage falls, thus reducing the overall power.

# Vega SmartPlus Application Notes

### 5.7.2 Latching Current Limit Mode

The latching current limit functions can be enabled by programming a location in EEPROM. In latching current limit mode, the output of the module is disabled if a pre-programmed current limit level, $I_{LIM}$, is exceeded for more than a certain period of time, $T_A$. Both the level and the time limit are stored in EEPROM.

The current limit activation level, $I_{LIM}$, can be programmed between 0 and 100% of the maximum module output current. The current limit activation time, $T_A$, is programmable between 1ms and 65s in 1ms steps.




In Latching current limit mode, if the reset function is not enabled, then the module can only be reset by one of three methods:

1) Forcing the global on/off input into the off state for more than 5ms, then returning to the on state.
2) Sending an software global off command followed by a global on command
3) By recycling the mains supply.

If the reset function is enabled, the module can be reset by one of two additional methods:

1) Forcing the module on/off input into the off state for more than 5ms, then returning to the on state.
2) By sending a software 'module on' command to the module in question.

In Latching current limit mode, the maximum peak current that can be drawn from a module is limited by the hardware current limit of the module. For hardware current limits see individual module specifications.

Latching current limiting is not available when the module is in default constant current, hiccup or current sharing modes.

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| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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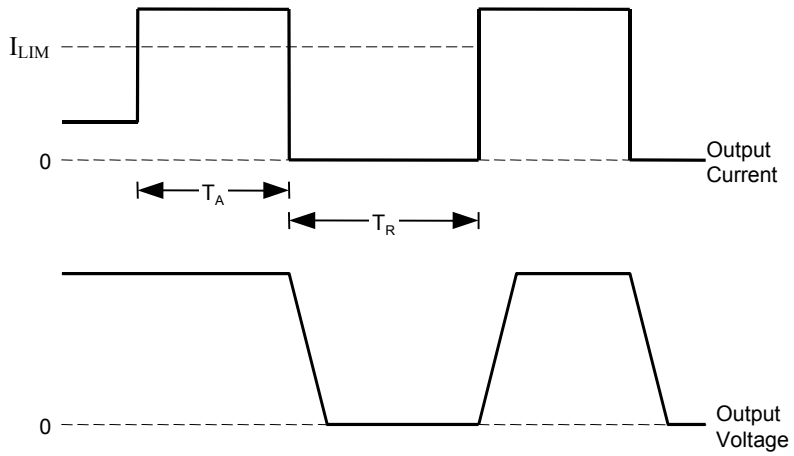
# Vega SmartPlus Application Notes

### 5.7.3 Hiccup Current Limit Mode

In Hiccup current limit mode, the functionality is identical to the Latching mode except the module resets itself after a second period of time, $T_R$.




The reset time, $T_R$, is programmable between 1ms and 65s in 1ms steps.

In hiccup current limit mode, the maximum peak current that can be drawn from a module is limited by the hardware current limit of the module. For hardware current limits see individual module specifications.

Hiccup current limiting is not available when the module is in default constant current, latching or current sharing modes.

| | | | | | | | |
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| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
| Initials: | JM | KM | KM | KM | | | |
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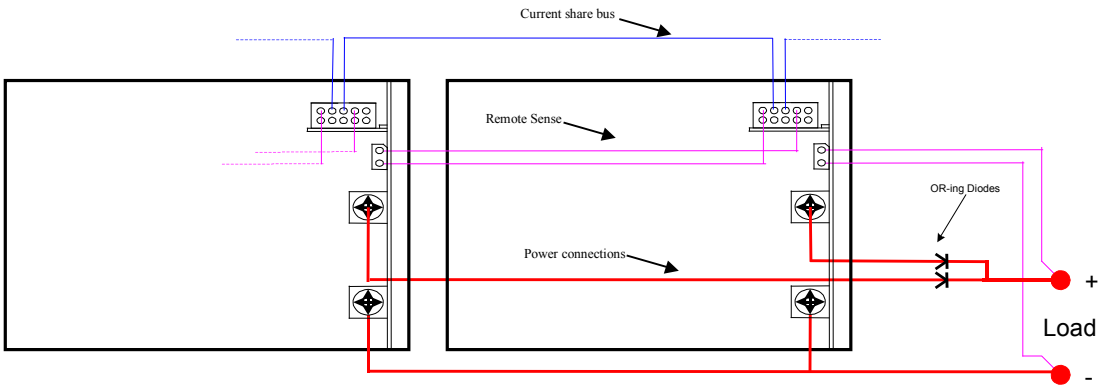
# Vega SmartPlus Application Notes

### 5.7.4 Current Sharing

When activated, allows multiple modules to be paralleled to provide a higher output current and or parallel redundancy. The current sharing function forces each module to supply the same current into the common bus. The modules can be connected with or without OR-ing diodes in the positive rail. Two current sharing connections are provided on the option connector to allow modules to be daisy chained.
Voltage Programming will interfere with the stability of the current sharing system. For modules with current sharing enabled, voltage programming should be set to zero/minimum and the correct output voltage set by the adjustment POT on each module.




To meet the transient response specification with sense connected, additional capacitance up to 10,000uF per Amp, may be added at the load. . The current sharing function can be disabled/enabled by programming a location in EEPROM. (NB version 2.01 of the interactive 'GUI' software has a known bug whereby the 'current sharing' enable button does not actually set the EEPROM location , direct software commands are required to set this loaction)

**See also:** ActiveX help file
Vega Development Kit

## 5.8 Voltage and Current Monitoring

The output voltage and output current of a module may be monitored via the serial connection using the 'GetOutputVoltage' and 'GetOutputCurrent' commands respectively.

**See also:** ActiveX help file
Vega Development Kit

| | | | | | | | |
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| Issue: | 1 | 2 | 3 | 4 | | | |
| Mod: | Release/24545 | 31530 | 31744 | 35479 | | | |
| Date: | 25.6.03 | 11.4.06 | 3.5.06 | 23.5.07 | | | |
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